FARADAY'S DIARY

Being the Various Philosophical Notes of Experimental Investigation

made by

MICHAEL FARADAY
D.C.L., F.R.S.

during the years 1820–1862
and bequeathed by him to the
ROYAL INSTITUTION OF GREAT BRITAIN
Now, by order of the Managers,
printed and published for the first time,
under the editorial supervision of
THOMAS MARTIN, M.Sc.

with a Foreword by
SIR WILLIAM H. BRAGG, O.M., K.B.E., F.R.S.
Director of the Laboratory of the
Royal Institution

VOL. I

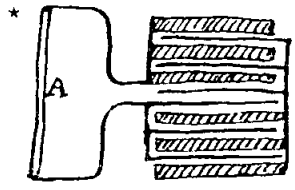
SEPT., 1820–JUNE 11, 1832

LONDON
G. BELL AND SONS, LTD
1932

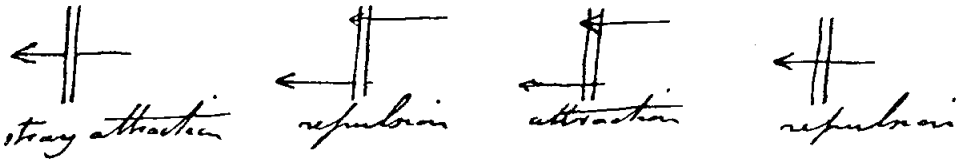
SEPT. 3RD, 1821.

Electromagnetic expts. with Hare's Calorimotor. To be remembered that this is a single series?

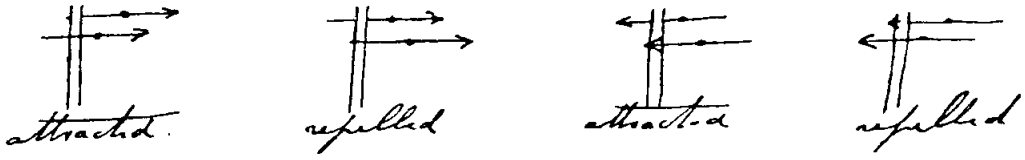
1. Position of the expt. wire A*.



2. Positions at first ascertained were as follows

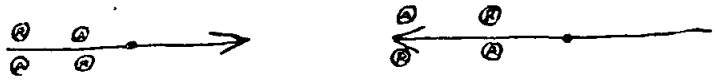


3. On examining these more minutely found that each pole had 4 positions, 2 of attraction and 2 of repulsion, thus

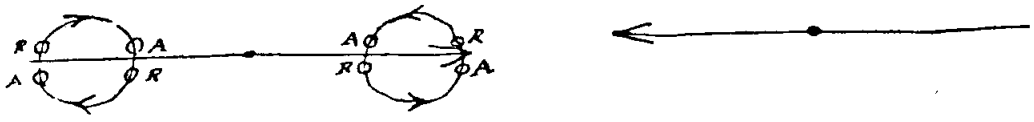


4. Or looking from above down on to sections of the wire

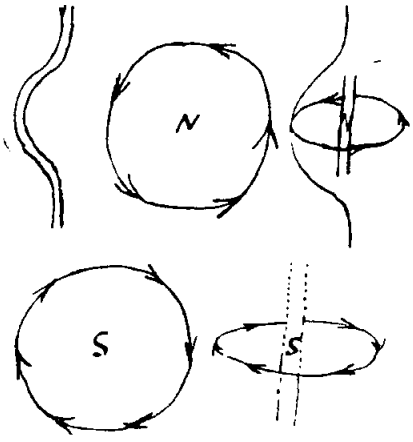
5. Or



6. These indicate motions in circles round each pole, thus



Hence the wire moves in opposite circles round each pole and/or the poles move in opposite circles round the wire. To establish the motion of the wire a connecting piece was placed upright in a cork on water; its lower end dipped into a little basin of mercury in the water and its upper entered into a little 7. inverted silver cup containing a globule of mercury; the arrangement of battery poles always as at first. Magnets of different



power brought perpendicularly to this wire did not make it revolve as Dr. Wollaston expected, but thrust it from side to side.

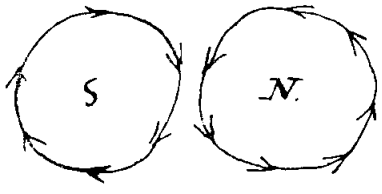
8, 9. The wire then bent into a crank form, thus, and by repeated applications of the poles of the magnets the following motions were ascertained, looking from above down on the circle described by the bent part of the wire, different Magnetic poles shewn by letters, North pole in centre. The rod in the circle is merely put there to shew the front and back part.

10. Magnetic poles on the outside of the circle the wire described*.

11. The effort of the wire is always to pass off at a right angle from the pole, indeed to go in a circle round it; so when either pole was brought up to the wire perpendicular to it and to the radius of the circle it described, there was neither attraction nor repulsion, but the moment the pole varied in the slightest manner either in or out the wire moved one way or the other.

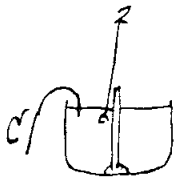
12. The poles of the magnet act on the bent wire in all positions and not in the direction *only* of any axis of the magnet, so that the current can hardly be cylindrical or arranged round the axis of a cylinder?

13. From the motion above a single magnet pole in the centre of one of the circles should make the wire continually turn round. Arranged a magnet needle in a glass tube with mercury about it and by a cork, water, etc. supported a connecting wire so that the upper end should go into the silver cup and its mercury and the lower move in the channel of mercury round the pole of the needle. The battery arranged with the wire as before. In this way got the revolution of the wire round the pole of the magnet. The direction was as follows, looking from above down [see diagram].



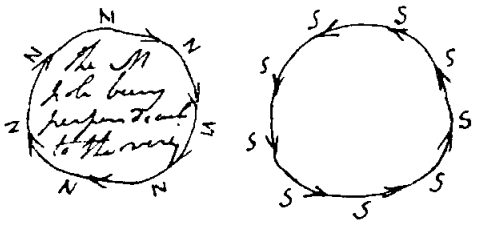
Very Satisfactory, but make more sensible apparatus.

TUESDAY, SEPT. 4.

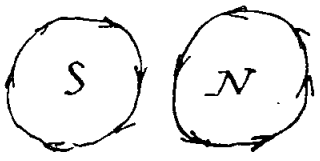


14, 15†. Apparatus for revolution of wire and magnet. A deep basin with bit of wax at bottom and then filled with mercury, a Magnet stuck upright in wax so that pole just above the surface of mercury, then piece of wire floated by cork, at lower end

* [10]



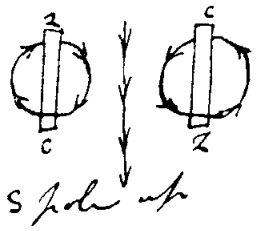
† [14, 15]



dipping into mercury and above into silver cup as before, and confined by wire or capillary attraction from leaving the M. Pole.

16*. Now Magnet round wire. The magnet had one pole so far sunk by platinum as to be low under the surface, leaving the other just above the surface whilst the whole floated; then the wire of connection was made to dip into the mercury near the pole.

17. The Magnet Pole floating between the two wires in the mercury proceeds one way or the other in a right line between them; or the other way if north pole up.

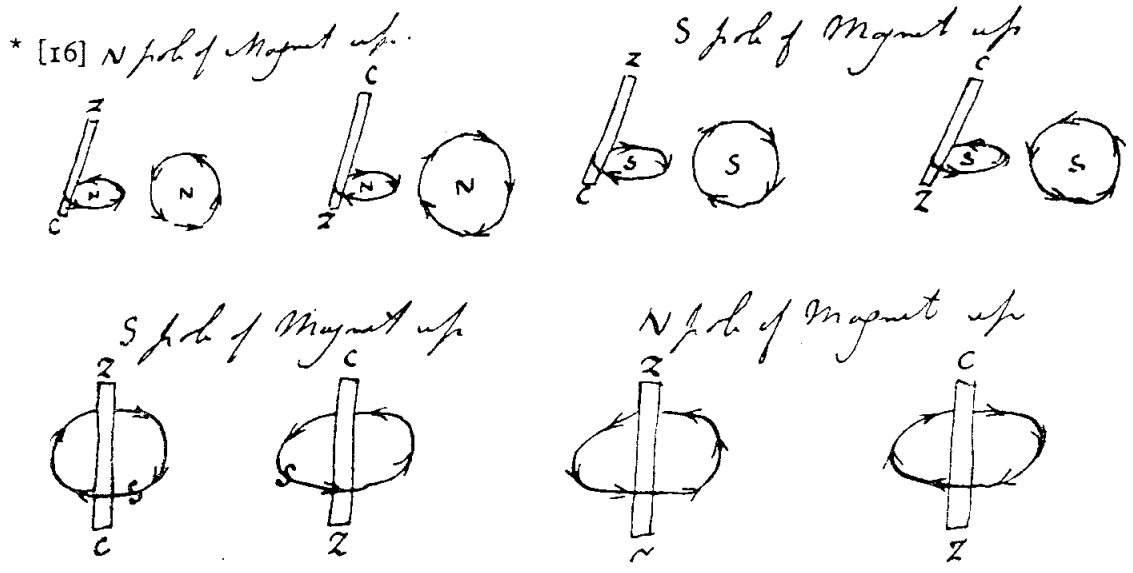


18. But when the two wires are from the same pole the magnet is unacted upon between them.

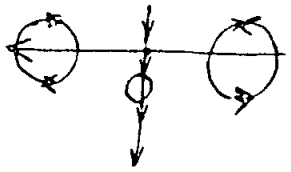
19. Could not make the Magnet or wire in the center turn round its own axis—but if the revolution depends on the motions of the currents essentially and not on the conductors except as the media, then perhaps those currents in the axis may turn without the media whilst those in the circumference cannot.

20. Every thing tends to prove that there is no attraction between the poles of the magnet and the wire, but only motion in a circular direction, and all the motions of the magnet or its poles about the wires may be deduced from this. When the single pole was floating upon the mercury it shewed it both by revolving round single wires and passing through double ones.

21. On floating a magnet horizontally on water at the bottom of which was mercury to connect the wires any where, the apparent attraction and repulsion of the poles were all reduced into the two circular motions about the wires. Hence also the reason why the magnet, when the connection is made, obeys both wires, taking a position exactly between them and with the poles as far as possible from the wire. It then goes to the nearest wire, but not by either pole but by its central point. And if the pole be put to the wire and slightly agitated the magnet will slip along the wire till midway across it.



ELECTRO-MAGNETISM.



22. Perhaps the settling of the needle perpendicular to the wire across it and then its approach on that side and its passing off on the other is the most instructive instance of attraction and repulsion. It is shewn that the attraction and repulsion, as they seem to be, are only the combined action of the two circles in which the poles endeavour to move round the wire, and two poles of different magnets, which alone merely tend to revolve round the wire in different directions, will, if tied together at a little distance from each other by a piece of thread, exhibit all the phenomena of attraction and repulsion that a complete magnet does.

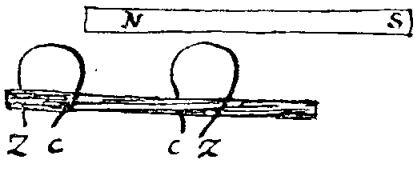
23. The indifferent state of Mag. pole and absence of axis is shewn by the wire revolving in all directions about it.

24. The double curve, each part goes the same way with the same pole and different ways with different poles, make revoln. the same way though on opposite sides of the wire. This strengthens the idea that it is not the wires but the currents that revolve, and shew[s] that it is not this or that side of the wire that has any relation to the pole, but the position of the current to the pole itself.

25. A magnet made part of the circuit shewed no difference of property by other magnets or wires. Except that it took up filings only at the poles when unconnected but all over when connected, dropping part when connection broken. The two Magnetisms do not seem to interfere; nevertheless there must be some effect. Try weak magnet.

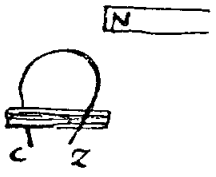
SEPT. 5TH, 1821.

26*. Expts. with De la Rive's Curve. The shaded bars are merely to show the position of the curves.



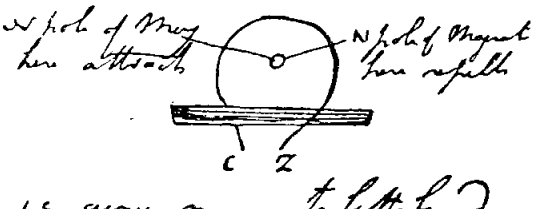
If the Mag. pole be above the curve there are particular positions as follows:

27. Rest in these positions, but if the part N be carried nearer to either of the curves they will move from it—the effect is for the curve to rise up and go over the N.

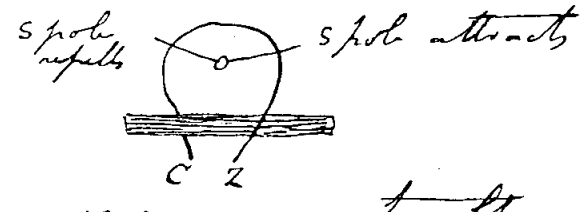


28. Here if N is exactly perpendicular to the plane of the curve it will attract it; if rather oblique to it it will turn the curve round and then repell it.

* [26]



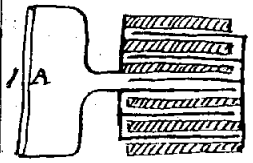
i.e. curve moves to left hand when N pole in centre



ie curve moves to right hand when S pole in centre

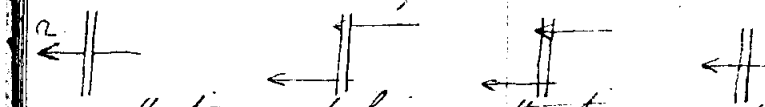
1821. Sept 3rd 1821.

Electromagnetic appts with Plate Calorimeter. To be remarked that this is a "myth" [illegible]

1 

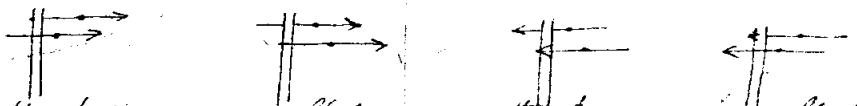
Portion of the appt with A

Portions at first ascertained were as follows

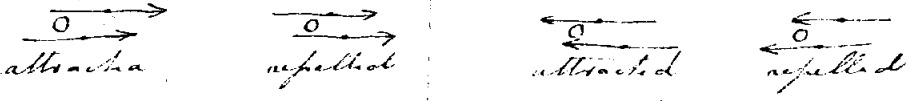
2 

on examining these more minutely found that each pole had a portion of attraction & of repulsion

3 Thus



or looking from above down on to portions of the wire

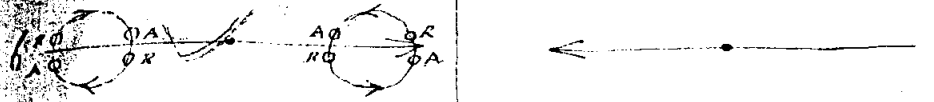
4 

or

5

These indicate motions in circles round each pole thus

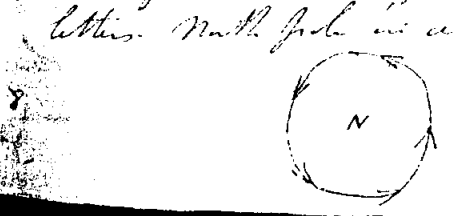
1821 Sept 3 19



Thus the wire moves in opposite circles round each pole & the poles move in opposite circles round the wire Ascertained the motion of the wire connecting these poles pleased especially in a cork on water to lower end dipped into a little basin of mercury in the water and its upper extremity into a little [illegible] cemented cork containing a globule of mercury.

The arrangement of poles always as at first to Magnets if different powers tested sometimes did not make it revolve as Dr Wollaston expected but turned it from side to side

The wire then bent into a crank form thus and by repeated applications of the poles of the magnets the following motions were ascertained. Looking from above down on the circle described by the bent part of the wire different Magnetic poles shown by letters North pole in centre

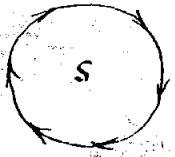


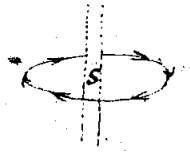
8

The rod in the circle is coming just thro the paper the part of it next

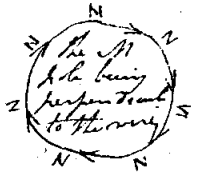
1891. Sept 3.

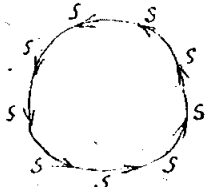
9





Magnetic poles on the outside of the circle as
were described





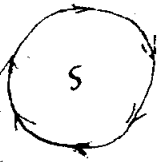
The effect of the wire is always to push off at a right angle from the pole indeed to go in a circle round it so when either pole was brought up to the wire perpendicular to it & to the radius of the circle it described there was neither attraction nor repulsion but the moment the pole was moved on the circumference in either direction the wire moved away in the same manner either if we put the wire round one way or the other

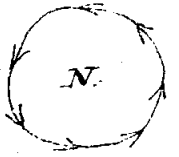
The poles of the magnet act on the bent wire in all positions and not in the direction only of any axis of the magnet so that the current can hardly be cylindrical or even round the axis for any length

From the action above a simple magnet pole in the centre of one of the circles should make the wire

1891. Sept 3 66

frictionally turn round round a magnet much in the same manner about it and by a cork water supported a current wire so that the upper end should go into the silver cup of mercury of the lower wire in the channel of mercury and the pole of the magnet the battery angled with the wire as before. In this way get the revolution of the wire round the pole of the magnet the direction was as follows looking from above down

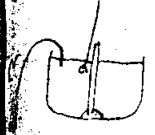




Very satisfactory, but make more sensible apparatus.

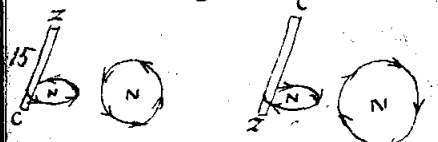
Tuesday Sept. 4

Apparatus for production of revolution of magnet. A deep basin with bit of wax at bottom of this filled with mercury. A magnet stuck upright in wax so that pole just above the surface of mercury. Then piece of wire floated by cork at lower end dipping into mercury of above into silver cup as before & supported by wire as carefully attached from hang the Mode

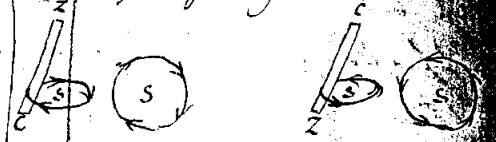


Sept 4. 1871

N pole of Magnet up.



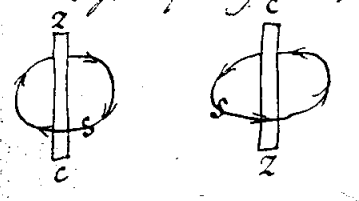
S pole of Magnet up



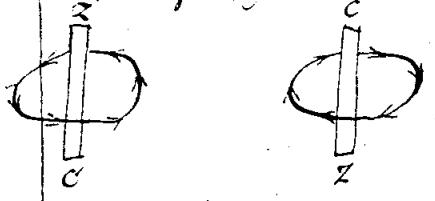
Electromagnetism

New Magnet and wire. The magnet had one pole so far melted by platinum as to be low under the surface having the other just above the surface when the whole floated. Then the wire of connection was made to dip into the mercury near the pole

S pole of Magnet up



N pole of Magnet up



The Magnet floating between the two wires in the mercury Poles

Proceeds one way or the other in a right line between them

or the other way if north pole up

S pole up

But when the two wires are from the same pole the magnet is unaffected when between them

Sept 4. 1871 67

could not make the Magnet or wire in the line round its own axis – but if the revolution depends on the motions of the currents spontaneously and not on the conductors except as the media then perhaps these currents in the axis may turn without the media whether there in the circumference cannot

Every thing tends to prove that there is no attraction between the poles of the magnet of the wire but only motion in a circular direction and all the motions of the magnet or its poles about the wires may be deduced from this. When the magnet was floating up on the mercury it showed it both by rowing round with wires of floating Pole down.

In floating a magnet horizontally on water at the bottom of which was mercury to connect the wires any where the apparent attracts & repulsions of the poles were all reduced into the two circular motions about the wires. Hence also the reason why the magnet when the connection is made stays both wires taking a position exactly between them and with

Sept 4. 1821

The poles as far as possible from the wire & therefore to the nearest wire but not by either pole but by its central point. And if the pole be just to the wire & slightly agitated the magnet will slip along the wire till midway across it.

Perhaps the utility & the mode perpendicular to the wire consist of this & approach or that mode and to pass off on the other is the most instructive exhibition of attraction & repulsion

It is shewn that the attraction & repulsion as they seem to be are only the combined action of the two circles in which the poles endeavour to move round the wire and two poles of different magnets which alone merely tend to revolve round the wire in different directions will if tied together at a little distance from each other by a piece of thread exhibit all the phenomena of attraction & repulsion that a magnet does

The indifferent state of any pole of above & apes is shewn by the wire revolving in all directions about it

A double curve each part goes the same way

Electromagnetic Rotations

Sept 4. 1821

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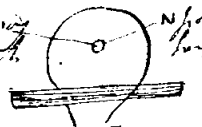
of the same pole and different ways with different poles & make each the same way that is on opposite sides of the wire shews strongly the idea that it is not the wire that is the cause of these that it is not that the currents that revolve of them that it is not that side of the wire that has any relation to the pole but the position of the current to the pole itself

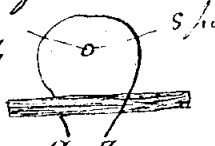
A magnet made part of the current shews no influence of polarity by the magnets or wires. Yet it took up filings only at the poles when connected but all over when connected & stiff part when connection broken the two Magnetisms do not seem to interfere never the less there must be some effect by such magnets

Sept 5th 1821

Fish with N. to the Eastward Curved the shaded bars are merely to show the position of the curves



the curve moves to the left hand when N pole in centre



the curve moves to right hand when S pole in centre